APPENDIX 20

Calculation of Net Load Increases from Diverting Future Wastewater Flows to On-Site Disposal Systems Instead of ENR POTWs

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Background

Most major publically-owned treatment plants (POTWs) in the Chesapeake Bay watershed currently hold nitrogen wasteload allocations (WLAs) that were calculated using a design/future flow value and a total nitrogen concentration that varies between 4 and 6 mg/L, depending on location. POTWs with secondary treatment typically discharge a concentration of 18 mg/L. The generally-accepted limit of technology (LOT) for nitrogen removal at POTWs is 3 mg/L, such that WLAs based on 4-6 mg/L represent an 80-93% of the maximum feasible reduction from the point source sector. Achieving these WLAs will reduce the point source component of the total annual nitrogen loading to the Bay to a single-digit percentage.

In addition to the environmental benefits of nutrient load reduction, a critical benefit of the current WLAs is the ability to manage future growth in the most environmentally beneficial manner. Specifically, current WLAs will allow many localities to direct a portion of wastewater flows from future growth to the most effective nutrient removal technology available (*i.e.*, BNR or ENR POTWs) rather than to less effective on-site disposal systems (OSDSs). In contrast, further reductions in WLAs could have the unintended consequence of increasing the net (POTW+OSDS) nitrogen loadings and causing environmental detriments associated with OSDS-based sprawl.

The USEPA Chesapeake Bay Program Office (CBPO) has indicated that forthcoming implementation plans for the Bay nutrient TMDL must account for growth. For the reasons given above, the interaction between POTW and OSDS loads is of high importance when considering future growth. To provide insight into these interactions, simple calculations were performed to quantify the net increase in nitrogen loading that could result from reducing POTW WLAs and directing the flow associated with the "lost" treatment capacity to OSDSs.

Methodology

Nitrogen loading calculations were performed to represent a 1.0-MGD ENR facility that has the concentration basis for its nitrogen WLA reduced from 4 to 3 mg/L, with the "lost" treatment capacity directed to OSDSs. The net increase in nitrogen loading to surface water would depend on the location and type of the new OSDSs. Higher nitrogen loadings would be associated with OSDSs in critical coastal areas or within 1,000 feet of perennial streams. Denitrifying OSDSs have lower nitrogen loadings the conventional septic systems. The following factors were used in the present calculation, and were obtained from the *Maryland Policy for Nutrient Cap Management and Trading in*

Maryland's Chesapeake Bay Watershed (Maryland Department of the Environment, 2008):

- 250 gal/day/OSDS
- Conventional OSDS loadings
  - 24.3 lb/yr/OSDS (critical areas)
  - 15.2 lb/yr/OSDS (within 1,000' of perennial surface water)
  - 9.2 lb/yr/OSFS (all other areas)
- Denitrifying OSDS loadings
  - 50% of the loadings of conventional systems

Results and Discussion

If a 1.0-MGD ENR facility had the concentration basis it nitrogen WLA reduced from 4 mg/L to 3 mg/L, the WLA would be reduced from 12,176 lb/yr to 9,132 lb/yr. If the plant is operating at 3 mg/L, the loss of 3,044 lb/yr WLA would prevent the plant from expanding to 1.33 MGD to accommodate growth. Thus, 0.33 MGD represents the flow that could potentially directed to OSDSs instead of the ENR facility. Because the calculations were performed on a unit basis, results can be interpreted as the potential nitrogen load increase associated with every 1 mg/L loss in WLA concentration basis per MGD POTW flow.

Directing wastewater to OSDS would increase the total (POTW+OSDS) nitrogen load by 24-241%, depending on the location and type of OSDS (Table 1). The highest increases (241%) would be associated with conventional OSDSs in critical areas. Such systems are not expected to be prevalent in Maryland due to a new state law. However, conventional OSDSs outside of the critical area are still associated with a 76-141% increases in the net total nitrogen load, relative to ENR treatment. Although denitrifying OSDSs provide some environmental benefit, they would still be associated with a 25-108% increase in the net nitrogen load to surface water, relative to ENR treatment.

Conclusions

Simple calculations confirm that reduction of the concentration-based of POTW WLAs could result in a net increase in total nitrogen loading to surface water, even using denitrifying OSDSs. Some of the potential increase could be prevented by wastewater recycle/reuse, depending on land availability, demand for recycle water, and costs. However, these calculations underscore the importance of joint planning of POTW and OSDS loads in light of future growth. POTW WLAs should accommodate future growth in the most environmental beneficial manner practical.

TABLE 1
Nitrogen Loading Increases by OSDS Type and Location
[Percent increases expressed relative to original WLA of 12,176 lb/yr for a 1 MGD POTW]

	Conventional OSDS Within Critical Area	Conventional OSDS Within 1,000 ft Buffer	Conventional OSDS Outside of 1000 ft Buffer	Units
OSDS Unit Load	24.3	15.2	9.2	lbs/yr/OSDS
Total OSDS Load[1]	32,400	20,267	12,267	lbs/yr
Combined POTW + OSDS Load[2]	41,532	29,399	21,399	lbs/yr
Net Load Increase over Orig. WLA[3]	241%	141%	76%	percent

	Denitrifying OSDS Within Critical Area	Denitrifying OSDS Within 1,000 ft Buffer	Denitrifying OSDS Outside of 1000 ft Buffer	Units
OSDS Unit Load	12.15	7.6	4.6	lbs/yr/OSDS
Total OSDS Load[1]	16,200	10,133	6,133	lbs/yr
Combined POTW + OSDS Load[2]	25,332	19,266	15,266	lbs/yr
Net Load Increase over Orig. WLA[3]	108%	58%	25%	percent

[1]Based on a total flow to OSDSs of 0.33 MGD.
[2]Calculated as the sum of the revised POTW WLA (9,132 lb/yr) and the OSDS load.
[3]Percent increase relative to the original POTW load of 12,176 lb/yr.